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지속가능한 도시 구현을 위한 스마트 그린인프라 정책사업 모델 개발방안 연구

Development of Smart Green Infrastructure Policy Business Models for Sustainable Urban Implementation

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Summary

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Introduction

Global climate change and rapid urbanization are threatening the sustainability of urban environments. As the frequency and intensity of climate-related disasters—such as heatwaves, floods, and particulate matter pollution—increase, new approaches are required to enhance urban resilience. Traditional Green Infrastructure (GI) performs ecological functions but faces limitations in efficient data-driven management and resolving complex urban problems. Consequently, Smart Green Infrastructure (SGI), which converges Nature-based Solutions (NbS) with Fourth Industrial Revolution technologies (IoT, AI, Big Data, etc.), is emerging as a viable alternative.

The purpose of this study is to develop effective 'SGI Policy Business Models' as a strategic tool for sustainable urban implementation. To this end, the study aims to define the concept of SGI, diagnose the limitations of current policies, identify core solutions for priority implementation, and present specific business models along with their economic feasibility.

The temporal scope of the study is set from 2025 to 2030, considering the target year for the Nationally Determined Contributions (NDC) for greenhouse gas reduction. The spatial scope encompasses the entire city, including 3rd Generation New Towns, with urban parks selected as the core space for empirical model design. The research was conducted in a four-stage framework: 1) Conceptual and theoretical establishment, 2) Diagnosis of current policy implementation status, 3) Derivation of core solutions and priority analysis, and 4) Design of policy business models and validation of

feasibility. The study utilized comprehensive qualitative and quantitative methodologies, including literature review, case studies, expert Delphi surveys, Importance-erformance Analysis (IPA), and Benefit-Cost Analysis (BCA).

Major Research Results

■ Conceptualization and Characteristics of SGI

SGI is defined as social infrastructure that fuses natural elements with data-driven smart operation systems to achieve climate crisis response, carbon neutrality, improved quality of life, and urban economic efficiency. Differentiated from traditional GI, SGI overcomes spatial constraints and management inefficiencies through enhanced spatial efficiency and performance, adaptive management for resilience reinforcement, and data-based performance visualization.

■ Diagnosis of Policy Status and Limitations

An analysis of local government smart city plans (63 cases) and central government public competition projects (149 cases) revealed that while GI-related services are expanding, they remain skewed towards simple convenience and tourism-oriented services. There is a relative lack of structural solutions for critical issues such as climate crisis response or aging society preparation, with limitations observed in the mere adoption of individual technologies rather than true technological convergence.

■ Derivation of Core Solutions and Priority Analysis

Based on the eight service sectors of the Smart City Act, an SGI solution inventory was constructed, and policy priorities were derived using expert IPA. The analysis classified solutions such as smart urban flood monitoring, smart heatwave management, and intelligent CCTV into the 'High-Performance/High-Demand' quadrant (Quadrant 1) for immediate adoption. Conversely, AI-based carbon reduction simulation and smart emergency response infrastructure were classified into the 'Strategic Investment' quadrant (Quadrant 4), requiring intensive development at the nat0ional level.

■ Design of Smart Park Policy Business Model and Economic Feasibility Analysis

An integrated Smart Park model was designed for a neighborhood park in a 3rd Generation New Town, incorporating strategies for 1) Climate Crisis Response (smart rainwater management, cooling fog, etc.), 2) Aging Society Response (digital healthcare, smart gardens), and 3) Advanced Mobility Accommodation (autonomous trails, smart shelters).The Benefit-Cost Analysis (BCA) results confirmed economic feasibility with a B/C ratio of 1.067 and a Net Present Value (NPV) of 400 million KRW. Although the initial investment cost is higher than that of general parks, the Smart Park model demonstrated superiority in total benefit scale due to operational efficiency and the creation of multidimensional social benefits (environment, health, safety, etc.).

Conclusion and Policy Implications

■ Summary

This study theoretically and empirically verified that SGI is a core infrastructure driving urban sustainability beyond simple technology application. In particular, the specific policy business model and economic analysis results targeting urban parks provide significant evidence for the feasibility of SGI projects.

■ Policy Implications

For the successful diffusion of SGI, the following are essential: 1) Expansion of policy scope to recognize SGI as multi-functional infrastructure for urban problem-solving, 2) Integrated reflection of SGI from the initial urban planning stage, 3) Establishment of a data-driven scientific decision-making system, and 4) Legal and institutional reforms to eliminate departmental silos. Furthermore, tailored investment strategies must be established based on the fiscal conditions and policy goals of local governments, weighing the trade-offs between cost efficiency and service advancement.

Keywords :
Urban Air Mobility, Rooftop Vertiport, Building, Selection Criteria, Assessment Indicator